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MILITARY SATELLITE SYSTEMS AND ANTISATELLITE ANTI-MISSILE TECHNOLOGY

by

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MILITARY SATELLITE SYSTEMS AND ANTISATELLITE [AND] ANTIMISSILE TECHNOLOGY

Abstract: Outer space is an area in which strategists of every nation are interested. Today, aerospace technology is not only used in satellite communications and aerospace technological research, it is also used towards military goals. The militarization of outer space is a new development trend. This document primarily addresses the development of military satellites, antisatellite weapons, and antimissile weapons by the world's military powers, with the United States as the leader.

Key terms: military satellites, antisatellite missiles, antimissile, missile, United States

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(I) MILITARY SATELLITE TECHNOLOGY AND APPLICATIONS

The U.S. is called master of the world. As far as great power development of space weapons is concerned, its technological level occupies a dominant position. Moreover, with regard to using military satellites directly in actual combat, military strategists unanimously believe that laboratory military systems are multipliers of military power. The Gulf War can be said to be a test of the weapons capabilities of the U.S. and its allies. It can also be said that it was a space war. They put to use 50 military and civilian satellites to support ground military activities. For example, as far as such ones as low orbit multiport communications satellites, KH-11 Big Bird reconnaissance satellites, SPOT remote sensing satellites, Leasat synchronous orbit satellites, high orbit GPS satellite nets, and so on, are concerned, we will now take the properties and the status of actual utilizations of military satellites and introduce them below.

1. Target Imagery Photographic Satellite Systems

As far as imagery photographing reconnaissance satellites used by the U.S. side are concerned, there are KH-11 visible light reconnaissance satellites and Lacrosse radar imagery reconnaissance satellites. Besides this, the commercial EOSAT and Landsat, as well as the French SPOT

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* Numbers in margins indicate foreign pagination. Commas in numbers indicate decimals.

satellites are also put to military uses.

(1) KH-11 Reconnaissance Satellites

KH-11's are developed from Big Bird model reconnaissance satellites (KH-9). Satellite weight is 13.3 tons. Length is 19m. The perigee of orbital motion is 325 km. The apogee is 600 km in a solar synchronous orbit. The two satellites are placed at symmetrical positions within the same orbital surface and form a pair. Satellites are capable of carrying out changes in orbit on the basis of mission requirements, carrying out detailed missions. There are two sets of cameras installed on satellites. One set is a high resolution CCD (charge coupling system) visible light camera. It is capable of supplying photographs with resolutions of 0.1 m. The other camera is a multiple frequency spectrum camera. The photographs this type of camera takes have the capability of identifying camouflaged targets. Satellite photographs are transmitted to the surface of the earth through intermediate relay satellites in the form of digital signals. The processing time for each photograph is a few minutes. As a result, it is possible to achieve near real time observation. KH-11 satellites are capable of tracking 42000 surface targets. Among these, half the targets belong to the former East European, and Soviet Union states, as well as China. The other half of the targets belong to other areas (including the Middle East). At present, there are two pairs of KH-11 satellites in orbit. Among these, one pair is an improved model KH-11.

(2) Radar Imagery Satellites

Due to visible light reconnaissance satellite operations being restricted by cloud cover and dark nights and their not being capable of all weather reconnaissance,

as a result, imagery technology has been developed in the radar wave band (cm waves) of operation, that is, composite aperture radar. Radar waves are emitted from satellites and go through reflection off the ground. Then, they are received again by satellites and formed into images. Following that, they are transmitted, sending signals to ground stations. The U.S. maintains two Lacrosse model radar imagery satellites in orbit. The resolution of the imagery taken by this type of satellite is 1 - 3 m.

(3) Military Applications of Commercial Remote Sensing Satellites

During the Gulf War, the U.S. EOSAT and Landsat, as /24
well as the French SPOT satellite all were put into military applications. Among these, the relatively typical one was the SPOT satellite.

The weight of the SPOT satellite is 1750 kg. Orbital height is 822 km. Orbital angle of inclination is 98.7°. Orbital repetition period is 26 days. Satellite CCD cameras operate in 4 wave bands. The main roles of SPOT imagery are target identification, positioning, and combat operation result evaluation. The advantages of SPOT satellite imagery are a large field of view (width 60 km) and better resolution than other remote sensing satellites (10 m). Moreover, it supplies digital imagery. After going through processing, it is capable of displaying three dimensional terrain maps. This type of terrain map is capable of helping aircraft pilots select attack routes, and, in conjunction with this, identify ground targets. According to reports, the U.S. has purchased SPOT data bases. In conjunction with that, they have bought second generation Fairchild-MSS2/DS mission support system computers to load digital imagery, supplying combat operational uses. The 18 U.S. Air Force detachments participating in the Gulf War were equipped with 45 sets of this type of system. After

the U.S. Defense Mapping Agency uses SPOT data, it put together maps with target positioning precisians smaller than 60 m.

Improvements in combat operation results by SPOT digital imagery were very clear. It made destruction probabilities for one precision guided bomb go up from 30% to 70%. Satellite imagery was also used in Tomahawk cruise missile terrain matching guidance systems. After the Gulf War, there was a great increase in the market for SPOT imagery. Buyers were the U.S. Navy, the French Air Force, as well as ministries of defense. In conjunction with this, there were at least two Asian countries that made purchases. They brought large amounts of SPOT imagery to use on military targets. The resolution associated with the next generation of SPOT satellites will go up to 5 m. Moreover, three dimensional imagery will be supplied directly.

Taking France as the chief among European nations, in order to shake off dependence on U.S. military satellites, they are in the midst of aggressively developing European military satellites. Among these are included the Helios optical reconnaissance satellite developed jointly by France, Italy, and Spain. The resolution of this type of satellite is 1 m. It is planned to launch the first satellite in 1994. Within 10 years, a total of 4 satellites will be launched. A number of other countries are in the process of planning purchases or development of reconnaissance satellites--for example, the United Arab Emirates, Korea, an Spain have already put forward purchase request for U.S. spy satellites. According to reports, the U.S. Itek company, which is responsible for the development of spy satellites, points out that, if the U.S. government allows the export of this type of satellite, it is only possible to provide capability for monitoring of certain specially designated areas. When it is in space above other

areas, the satellite will automatically turn off.

2. Navigation Positioning Satellite Systems

As far as the U.S. global positioning system (GPS) satellite net is concerned, it is planned to be composed of 24 satellites. The satellite position distribution is that each orbital surface includes 4 satellites. There are a total of 6 orbital surfaces. Orbital angle of inclination is 55°. Orbital altitude is 20233 km. Carrier wave frequencies are L1 = 1227 MHz, L2 = 1575 MHz. Navigation data code speed is 50 bit/s. Each GPS satellite weighs 2032 kg. At present, there are a total of 16 satellites in orbit. There are two types of GPS systems. One type is C/A code. Positioning accuracy is specified at 100 m. According to reports, this type of code is, in reality, capable of reaching accuracies of 35 m. The reason is that this accuracy already approaches requirements for military use. As a result, it has been lowered to 100 m to supply commercial uses. Another type is P code. This is especially for military uses. The positioning accuracy is 18 m. During the Gulf War, limitations were placed on non-U.S. users making use of GPS signals. In C/A code, special codes were added, supplying battlefield utilizations. In the middle 1990's, the U.S. plans to launch new GPS satellites. The positioning accuracy will be further improved.

3. Missile Warning Satellites

The U.S. and the former Soviet Union both launched strategic missile warning satellites. The U.S. warning satellites are called DSP (Defense Support Projects). Satellites weigh 900 kg. They are positioned in equatorial upper fixed point orbits. They make use of infrared satellite detection of infrared signals given out by missile launches. Through analyzing the strength of these signals

as well as differences with the cold background of the earth, missile models are distinguished. In accordance with this, these signals are taken and sent to ground ballistic missile warning systems to calculate the points of fall of the missiles. During the Gulf War, the U.S. military took at least two DSP satellites and turned them over the battle area. They were used to monitor Iraqi launches of Feimaotui (phonetic) tactical missiles. Infrared telescopes on satellites scan once every 12 seconds, supplying nearly real time information. This information goes through U.S. Air Force computer processing. 120 seconds after missile launch, there is warning of point of fall, giving the front line 90 seconds warning time. This type of information simultaneously guides Patriot missiles in carrying out intercept. It also gives Feimaotui (phonetic) missile launch points in order to organize bombing of the launchers. Beginning in 1994, the U.S. will develop a new generation of warning satellites. In conjunction with this, warnings against tactical missiles will be strengthened.

4. Military Communications Satellite Systems

A representative military communications satellite in /25
current use is the U.S. Defense Satellite Communications System-- III. Similar to it, there are also the European Skynet 4 satellite as well as the U.S. Fleetsatcom, and so on. DSCS--III satellites weight 1042 kg. The satellite body presents a cubical form. The three axses are stable. There is a solar panel pointed toward the sun. The satellite has antiinterference and antijamming measures. There are two types of antennas on the satellites. One type is a multiple beam antenna. It possesses the capability of receiving 61 beams. Another type is two 19 beam receiving antennas. The wave form diagrams for the antennas are controled from the ground. It is possible to select

satellite coverage areas. Satellite operating life is 10 years.

During the Gulf War, the Allies made use of 11 communications satellites to carry out communications and command. Among these were included Leasat as well as the experimental model MAC satellite. Due to the fact that amounts of data flow are very large for such things as intelligence, command, communications, and so on, in modern war, the communications satellites discussed above have not satisfied requirements. It is particularly true that basic level units often were unable to get contact upward. As a result, after the battle, the U.S. and its allies unanimously called for the acceleration of the development of small model military communications satellites in order to resolve wartime communications congestion problems.

U.S. military communications satellites under development include Milstar (military strategic, tactical, and relay satellite), as well as small model Tacsat communications satellites. Milstar opts for the use of EHF frequency bands (upper line 44 GHz, lower line 20 GHz) increasing satellite processing capabilities, strengthening nuclear hardening, as well as antilaser weapon capabilities and raising survival capabilities. Constellations of satellites are composed of 4 satellites in synchronous satellite orbits as well as 4 satellites in large elliptical orbits. Among these, there is one satellite each which is a spare. Between various satellites of the constellation, there are interconnecting communications links (frequency band 60 GHz) in order to reduce dependence on ground stations. In situations where ground station support is lost, communications nets are capable of operating autonomously for half a year. In order to strengthen antijamming capabilities, Milstar--in the areas of frequency band selection and antenna design--opts for the adoption of

measures in both, causing performance to very greatly improve.

5. Electronic Eavesdropping Satellite Systems

The U.S. and the former Soviet Union both developed and deployed electronic eavesdropping satellite systems. According to reports, the former Soviet Union's electronic eavesdropping satellite systems were composed of a constellation of 6 satellites. Orbital altitude was 650 km. U.S. electronic eavesdropping satellites went through two generations of development. At the present time, the code names of the two types of satellites are Vortex and Magnum. The key functions of electronic eavesdropping satellites are to gather data associated with ground radar systems and monitor missile test telemetry data, as a result, determining missile performance. During periods of combat operations, they are also capable of eavesdropping on enemy combat orders as well as secret codes, and so on. Due to the fact that electronic eavesdropping satellites are highly classified projects, open source information is very scarce.

(II) ANTISATELLITE WEAPON DEVELOPMENT

The U.S. and the Soviet Union both developed antisatellite weapons. In conjunction with this, multiple iterations of antisatellite tests were carried out. The U.S. Vought company developed a type of small model homing vehicle (MHV). Its weight was only 16 kg. Its diameter was 30 cm. Its length was 33 cm. The rounds had installed on them 8 infrared telescopes.

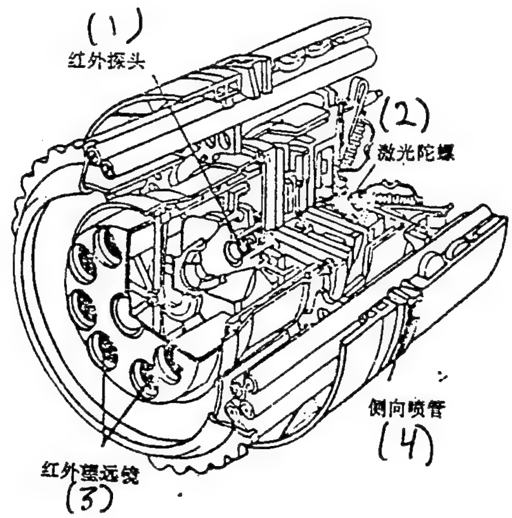

Fig.1 Small Model Antisatellite Homing Round (1) Infrared Detector (2) Laser Gyroscope (3) Infrared Telescopes (4) Lateral Jet Tubes

They track and aim at targets. Installed on the rounds are ring shaped laser gyroscopes as well as micro computers. During flight, they are spin stabilized. Solid fuel rockets are utilized to change flight direction. This type of round has no warhead. It is completely dependent on its own momentum to collide with the target. On this foundation, the U.S. LTV company developed a type of antisatellite missile. The missile weight was 1200 kg. Overall length was 5.3 m. Maximum diameter was 0.505 m. The missile included a two stage solid rocket. Within the full cowling of the nose cone, there was installed a homing round as shown in Fig.1. The missiles were launched from F-15 aircraft. Altitude at launch was approximately 12 km. Velocities approached the speed of sound. A total of 5 flight tests were carried out. The final one successfully destroyed a satellite. In 1988, due to funding problems and the restraints of arms control negotiations, this project was temporarily halted.

After the Gulf War, the U.S. military once again /26
stressed the importance of antilaser weapons. The first target hit by antisatellite weapons was a reconnaissance satellite with the imagery capabilities of a civilian satellite as well. The U.S. Defense Department set up a combined antisatellite project office participated in by the Army and the Air Force. The project will carry out new antisatellite tests beginning in 1996. This type of new model antisatellite missile is fired from the ground and opts for the use of a new destructive mechanism. When missile and satellite meet, a large polyester plate is used to swat the satellite (Fig.2), causing the instruments inside the satellite to malfunction. Moreover, satellites still maintain an intact outside form. In this way, it is possible to reduce space debris. This type of destruction

mechanism has already achieved empirical verification in ground tests.

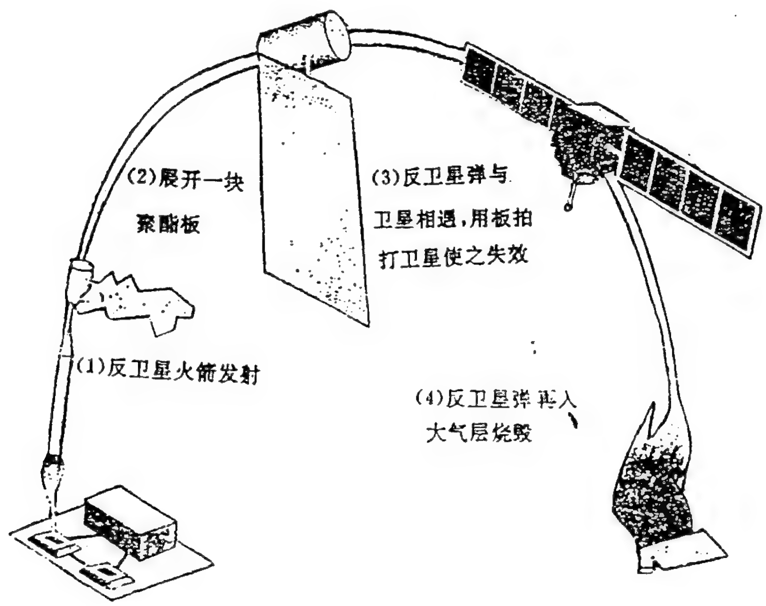

Fig.2 Diagram of Antisatellite Weapon Principles (1) Antisatellite Rocket Launch (2) Open Up a Piece of Polyester Plate (3) Antisatellite Round and Satellite Meet Each Other Using the Plate to Swat the Satellite Causing It to Malfunction (4) Antisatellite Round Reenters the Atmosphere and Burns Up

Due to the fact that the role of military satellites is strengthened in regional conflicts, quite a few nations will develop military use satellite systems. At the same time, even more nations will seek antisatellite capabilities.

(III) ANTISATELLITE WEAPON DEVELOPMENT

Antimissile weapons began development at almost the same time as intercontinental missiles. In the 1960's, the U.S. developed Nike-Zeus as well as the Weibing (guard or sentry) antimissile system. These antimissile missiles are fired from the ground using high altitude nuclear bursts as their killing and wounding mechanism. Due to the effectiveness of the entire system being bad, there was no deployment. The former Soviet Union also developed the relatively primitive "rubber overshoes" antimissile system with a similar mechanism. In conjunction with this, 64 launchers were deployed in the Moscow area.

In the 1970's, both the U.S. and the Soviet side stepped up development of offensive missiles, preparing multiple warheads and defense penetration measures. In the area of antimissile research, no progress was achieved of a breakthrough nature.

In 1983, the Reagan government put forward the Strategic Defense Initiative (SDI). Its main argument is that the defensive deterrence strategy must be replaced with an offensive deterrence strategy. The SDI plan is a research development plan. The object is to set up a ballistic missile defense system which unites space and the earth in order to offset the nuclear missile threat. The core technologies of the SDI project are space based antimissile technology as well as boost phase intercept, opting for the use of nonnuclear killing and wounding technologies.

Space based missile counters are divided into the two types of directed energy weapons and kinetic energy weapons. Going through many years of research, in the SDI project, the U.S. temporarily discarded the development of directed energy weapons. The cause was--in the short term--wanting

to make laser weapon powers reach levels capable of killing and damaging missiles beyond several thousand kilometers. Possibilities were not great. The reason was that key points of research were concentrated on kinetic energy weapon development.

The dissolution of the former Soviet Union announced /27 the end of the cold war era and stimulated movements in strategic missile defense trends toward moderation. From handling an all out attack from the Soviet Union, the U.S. SDI system was changed into a global defense system to handle limited attacks associated with accidental launches and unauthorized launches (simply called the GPALS system).

The initial capabilities of the GPALS system are to intercept an attack of 200 warheads. The GPALS system is composed of three large parts: (1) a transportable theater/tactical ballistic missile defense system (TPALS), used to protect allies of the U.S. as well as overseas U.S. military bases; (2) the continental U.S. base antimissile system (CPALS). It is composed of antimissile direction centers, hardened radars, temporary take off detection devices, and base intercept missiles; (3) space based antimissile systems. These are composed of BP missiles and BE monitoring satellite networks. Space based antimissile systems are primarily used to intercept attacking ballistic missiles in power phases of flight.

In 1991 the U.S. Congress passed an antimissile bill. determining, in this century, to first set up in the continental United States a ground based antimissile defense zone, postponing the deployment time of space based antimissile systems.

1. Antitactical Missile Development

At the present time, only the Patriot missile system is in use as an antitactical missile. The Patriot missile was

originally one type of air defense missile produced by the U.S. Raytheon company. Going through improvements, it possessed antimissile capabilities. The missile weight is 900 kg. Diameter is 0.39 m. The length is 5.3 m. The wingspan is 0.85 m. The missile system is composed of missile, phase control array radar, computer systems, as well as missile launch systems, and so on. The missile intercept altitude is approximately 7 km. With regard to Patriot missile combat results, after the Gulf War, a very large debate occurred. The U.S. Army said the success rate was 50% - 80%. However, a number of critics believe that it is only 15% - 20% or even lower. There are analytical reports which point out that modified Feimaotui (phonetic) missiles (that is, houyingu (phonetic) type missiles), due to their long bodies, just break up themselves on reentry into the atmosphere. They become many targets and they produce problems for Patriot missile intercepts. There are also specialists who believe, after citing statistical data, that Patriot missile intercept altitudes are relatively low. After intercepts, even more damage is caused on the ground. However, no matter what the criticism is like, Patriot missiles created a precedent for the use in actual combat of antimissile missiles.

After the Gulf War, various countries set off an enthusiasm to develop tactical antimissile missiles. The U.S. Congress set up a theater missile defense structure. Western Europe and Japan also began to generate interest in developing tactical antimissile missiles. The U.S. Army has already begun to improve the performance of Patriot missiles on hand, improving system quick response capabilities, improving guidance systems, and expanding the scope of defense coverage. At the same time, they are in the midst of developing a new generation of PAC-3 model Patriot

missiles. Installed on the missiles are active type radars, increasing antiinterference capabilities.

Besides Patriot missiles, there is the Arrow type tactical antimissile missile developed cooperatively by the U.S. and Israel. The defense area of the Arrow type antimissile missile is larger than the Patriot's, using 3 antimissile missile launches to intercept each attacking missile. The U.S. has also developed in its own country theater high altitude antimissile missiles, code named Thaad. Their characteristics and those of the Arrow type missiles are similar. They belong to the GPALS system missiles. Besides this, the U.S. has also developed even more advanced Aces missiles.

2. Ground Based Intercept Missiles

There are two types altogether of ground based missiles belonging to the GPALS system, that is, exoatmospheric interceptors and endoatmospheric interceptors or E2I. On the basis of calculations, in order to make the defensive area completely cover the U.S., 600 - 800 ground based antimissile missiles are needed. 7 antimissile missile bases are constructed. Among these, 5 are on the U.S. mainland. In addition, one is built in each of Hawaii and Alaska.

Ground based interceptor missiles are composed of two parts- -booster rockets and killer missiles as shown in Fig.3. Booster rockets are a two stage solid rocket. The take off velocity is large. Booster rockets used in tests are composed of second and third stages of Minuteman missiles.

The U.S. is in the midst of testing two types of killer missiles. One type is a light model exoatmospheric interceptor missile (LEAP). See Fig.4. Another type is the ERIS experimental missile. The mass of the LEAP missile is

6 kg. They are developed separately by the Boeing company, the Hughes company, and the Rockwell company. Key technologies associated with LEAP missiles are set out below:

(1) Attitude Control Rocket Motors: There are two designs- -liquid rocket and solid rocket motors. Small model liquid attitude control motors are developed by the Marquardt company and the Aerojet company. The propellant is hydrazine/dinitrogen tetroxide. Solid attitude control motors are developed by the Thiokol company. The motors in question use rhenium alloys to make valve materials. Under combustion gas temperature conditions of 2200°C, motor operations pulse 200 times a second.

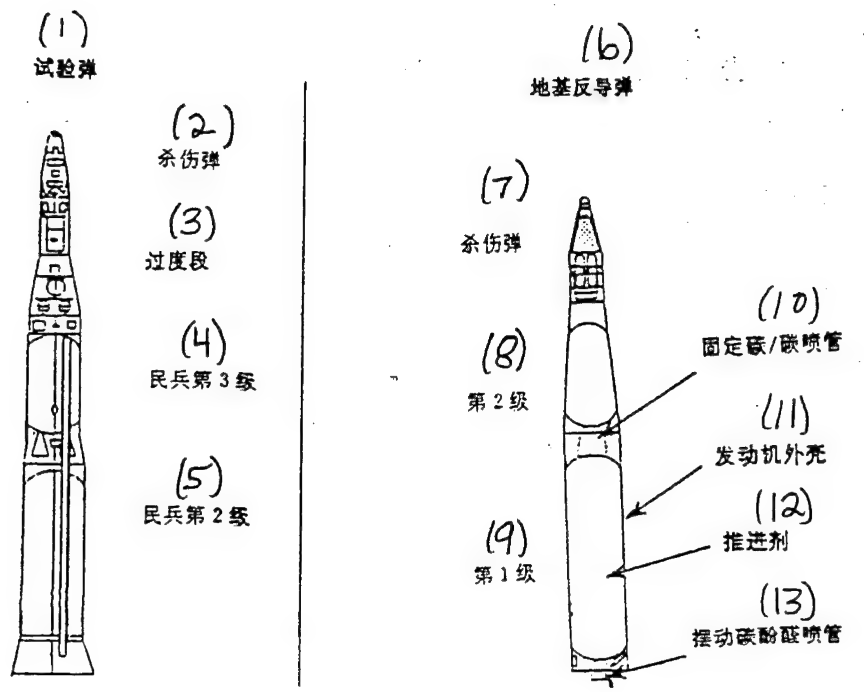

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Fig.3 Ground Based Antimissile Missile Schematic (1) Test Missile (2) Kill Missile Round (3) Transition Section (4) Minuteman Third Stage (5) Minuteman Second Stage (6) Ground Based Antimissile Missile (7) Kill Missile Round (8) Second Stage (9) First Stage (10) Fixed Carbon/Carbon Jet Tube (11) Motor Outer Shell (12) Propellant (13) Swiveling Carbon

(2) Infrared Detector: It is a 128x128 element tellurium- cadmium-mercury infrared focal surface array detector. It went through flight tests successfully. Target tracking distances have already reached 16 km.

(3) High Density Electronics Package: The Hughes company LEAP missile uses a thin plate with a weight of 0.17 kg and a diameter of 140 mm with detector signal processors, guidance and control systems, as well as telemetry system electronic components installed on it.

ERIS exoatmospheric test missiles possess the capability to identify decoys. The killing and damaging mechanism is to extend a plastic net, destroying the warhead as shown in Fig.5.

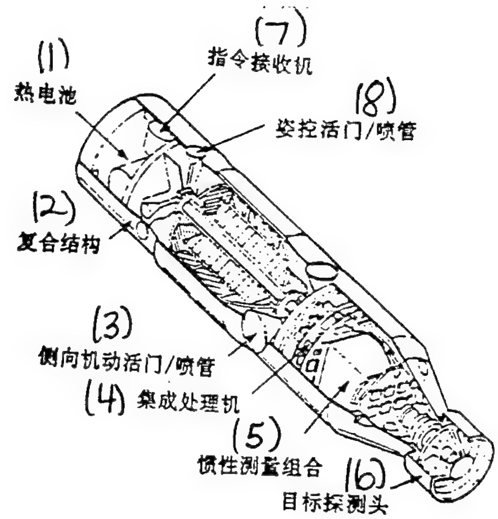

Fig.4 LEAP Test Missile Schematic (1) Thermoelectric Cell (2) Composite Structure (3) Lateral Maneuver Valves/Jet Tubes (4) Integrated Processors (5) Inertial Measurement Assembly (6) Target Detection Head (7) Command Receiver (8) Attitude Control Valves/Jet Tubes

3. Space Based Antimissile Missiles--BP Systems

BP is a space based antimissile net spread in near earth orbit (altitude 400 - 500 km). The total number of antimissile missiles in orbit is approximately 1000. Missiles formed into sets (5 - 10 missiles to a set. See Fig.6.) are placed in orbiting mother compartments or platforms. Mother compartments give missiles life supporting outer shells, guaranteeing environmental conditions and power sources. In conjunction with this, they carry propulsion systems needed to maintain orbit for 10 years.

The special characteristics of BP systems are that they are small, light, and low cost. As much as possible, option

is made for the use of miniaturized, ready made commercial or military technology. According to reports, each platform weighs 90 kg. Its dimensions are smaller than a normal desk. On each platform, there are installed a set of solar panels, real time star light navigation systems, standardized small angular velocity meters as well as linear acceleration meters. In conjunction with that, use is made of high precision time pieces for support, making it possible as needed to know their own position and direction.

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On platforms as well as missiles, there are installed miniaturized, high resolution, wide field of view short/medium wave infrared photographic systems (using tellurium-cadmium- mercury focal surface arrays). As far as radio contact between platforms and the ground are concerned, opting for the use of gallium arsenide chip integrated circuit technology, dimensions and weight are reduced. Missiles opt for the use of high performance solid rocket motors as well as terminal maneuver propulsion systems. Option is made for the use of miniaturized optical fiber gyroscopes as well as silicon accelerometers and inertial assemblies weighing 0.17 kg. Computers onboard missiles opt for the use of very high speed integrated circuits (VHSIC) weighing 0.23 kg. The operational capabilities are equivalent to 2/3 of a Cray-1 computer.

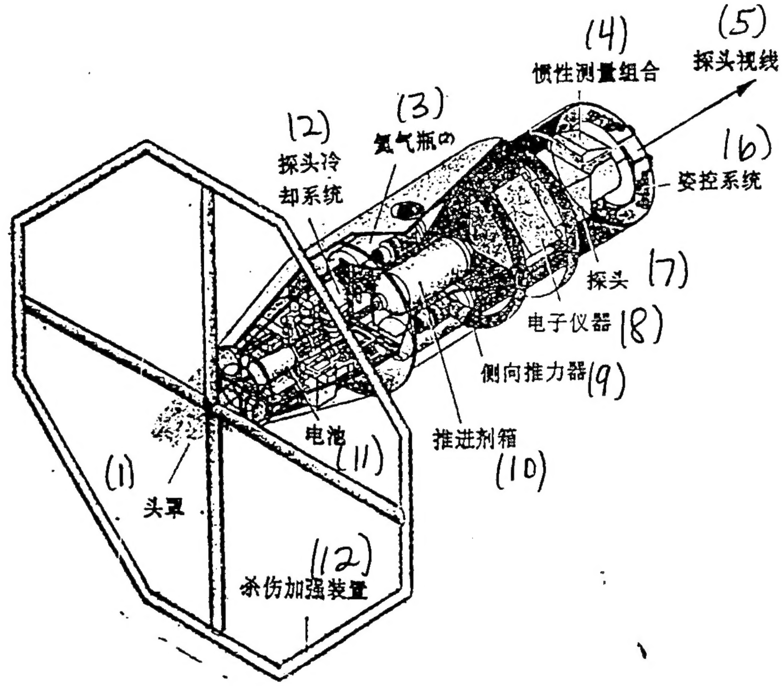

Fig.5 ERIS Test Missile Structural Diagram (1) Nose Cover (2) Detector Cooling System (3) Helium Gas Bottles [2] (4) Inertial Measurement Assembly (5) Detector Line of Sight (6) Attitude Control System (7) Detector (8) Electronic Instruments (9) Lateral Propulsion Devices (10) Propellant Tank (11) Electric Cells (12) Kill and Damage Strengthening System

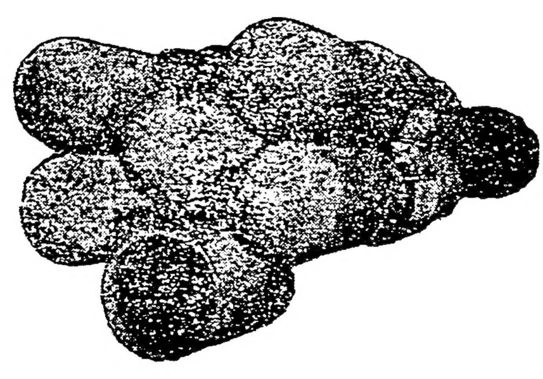

Fig.6 BP Space Based Antimissile Schematic

BP missile operating processes are divided into two stages: (1) awakening process. In this process, platforms take data on their own position vector quantities as well as target data and pass it on to the missile. In conjunction with this, target indicator devices on missiles are activated. (2) After going through calculations, missiles are launched toward predetermined hit points. During launch processes, two booster rocket stages of missiles operate. The operating time for each stage is 5 - 10s, causing missiles to achieve increases in velocity of approximately 10km/s. When missiles approach areas of targets, homing systems on missiles as well as maneuvering systems operate. In conjunction with this, targets are finally hit.

BP missile plan design has been carried out by the TRW company and the Martin company separately. Presently, they have already entered into the design flight test phase.

Paired together with BP missiles in sets are space based BE satellite systems. Their function is to carry out tracking and positioning of targets. In conjunction with this, they supply data to BP systems. According to reports, BE systems, after construction, will have 50 BE satellites in orbit at altitudes of 700 - 1600 km in order to satisfy the requirements of global coverage. The mass of each satellite is less than 450 kg. The satellites are all equipped with two telescopes. The main telescopes operate in the long wave long infrared (LWIR/VLWIR). Auxiliary telescopes operate in visible light and middle wave length infrared (MWIR). In addition, they are equipped with laser beam radar direction finding devices used in order to precisely determine target distances and state vector quantities.

From the situation introduced above, it is possible to explain military satellites, antisatellite weapons, tactical

antimissile missiles, as well as strategic antimissile missiles being in the midst of rapid development. Weapon miniaturization technology and new nonnuclear kill and damage mechanism technology breakthroughs will cause the next generation of tactical and strategic weapon development to bring with it new changes.

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